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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/649,256	08/27/2003	Satyavolu S. Papa Rao	TI-35916	7202

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EXAMINER	
NGUYEN, THANH T	

ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 04/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/649,256	PAPA RAO ET AL.	
	Examiner	Art Unit	
	Thanh T. Nguyen	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 August 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *3/30/04*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Information Disclosure Statement

The information disclosure statement filed on 8/27/03 has been considered.

Oath/Declaration

Oath/Declaration filed on 8/27/03 has been considered.

Specification

The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 11 are rejected under 35 U.S.C. 102(e) as being anticipated by Andricacos (U.S. Publication No. 2004/0028882).

Referring to figures, Andricacos et al. teaches a method for forming integrated circuit copper lines, comprising:

Forming a trench (3, called opening) in a dielectric layer (2, called insulating material);

Forming a first metal layer (5, palladium) in the trench using physical vapor deposition (see paragraph 15) and a high atomic number metal (see figures 3-4 and paragraph 15);

Forming a second metal layer (5, platinum) in the trench over the first metal using chemical vapor deposition and a high atomic number metal (see figures 3-4 and paragraph 15); and

Filling the trench with copper by electroplating copper (6/7, see paragraphs# 16/22) directly on the second metal layer.

Claims 1-2, 11-12, 17 are rejected under 35 U.S.C. 102(e) as being anticipated by Kim (U.S. Publication No. 2002/0185671).

Referring to figures 1a-1f, Andricacos et al. teaches a method for forming integrated circuit copper lines, comprising:

Forming a trench (19, called via hole) in a dielectric layer (14/15/16/17/18);

Forming a first metal layer (20/21, Pt/Ru/Ir/W) in the trench using physical vapor deposition (see paragraph 52) and a high atomic number metal (see figures 1C and paragraph 52); Noted for the purpose of rejecting claim 17, wherein exposing the first metal layer (20) to a plasma treatment (see paragraph# 49)

Forming a second metal layer (23, Pt/Ru/Ir/W) in the trench over the first metal using chemical vapor deposition and a high atomic number metal (see figures 1C and paragraphs# 52); and

Filling the trench with copper by electroplating copper (26, see paragraphs# 67-69) directly on the second metal layer.

Regarding to claims 2, 12, high atomic number metal is selected from a group consisting of Ru, Ir, Rh, and Pd (see paragraphs #52).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 3-10, 13-16, 18-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim (U.S. Publication No. 2002/0185671) as applied to claim 1-2, 11-12, 17 above in view of in view of Wolf "Silicon Processing for the VLSI ERA" vol. 1, pages 335-374) and Vaartstra et al. (U.S. Patent No. 6,074,945).

Referring to figures 1a-1f, Andricacos et al. teaches a method for forming integrated circuit copper lines, comprising:

Forming a trench (19, called via hole) in a dielectric layer (14/15/16/17/18);

Forming a first metal layer (20/21, Pt/Ru/Ir/W) in the trench using physical vapor deposition (see paragraph 52) and a high atomic number metal (see figures 1C and paragraph

52); Noted for the purpose of rejecting claim 17, wherein exposing the first metal layer (20) to a plasma treatment (see paragraph# 49)

Forming a second metal layer (23, Pt/Ru/Ir/W) in the trench over the first metal using chemical vapor deposition and a high atomic number metal (see figures 1C and paragraphs# 52); and

Filling the trench with copper by electroplating copper (26, see paragraphs# 67-69) directly on the second metal layer.

Regarding to claims 2, 12, high atomic number metal is selected from a group consisting of Ru, Ir, Rh, and Pd (see paragraphs #52).

However, Kim does not teach forming a ruthenium layer using a plasma excitation power of 100-1000 Watts with a DC power to 4KW to 30KW applied to a sputter metal target, and flowing a vapor containing Ruthenium over a surface heated to between 100-350°C, and the thickness of the first metal layer is less than 50A° thick.

It is known in the art that PVD (Physical Vapor Deposition) including the step of plasma excitation to a sputter metal target (see Wolf, vol. 1, pages 335-353) (meeting claims 4, 7, 13, 18, 20).

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would depositing a metal layer (Ruthenium) by using PVD (Physical Vapor Deposition) including the step of plasma excitation to a sputter metal target in process of Kim as taught by Wolf because the process would easily control the film thickness and also provide a uniform thickness.

Vaartstra et al. teaches forming a Ruthenium layer by vapor process by depositing a layer at the temperature of about 150-350°C (see col. 4, lines 14-49) (meeting claims 4, 7, 14, 19).

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would form a Ruthenium layer by vapor process by depositing a layer at the temperature of about 150-350°C in process of Kim as taught by Vaartstra et al. because the process would provide a good step coverage.

Regarding to claims 5-6, 9-10, 15-16, 21-22, it would be obvious to one ordinary skill in the art to form a plurality of metal layers in the to fill the trench, since it is well-known in the art to repeat the same process for multiple effect. See St. Regis paper, Co. V. Bemis Co. Inc. 193 USPQ 8, 11 (7th circuit 1977).

The specific power range, temperature range, thickness range are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in In re Aller, the selection of reaction parameters such as temperature would have been obvious:

> "Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed "critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."
> *In re Aller 105 USPQ233, 255 (CCPA 1955). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmscher 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).*

Therefore, one of ordinary skill in the requisite art at the time the invention was made would have used any power range, temperature range, thickness range suitable to the method in process of Kim in order to optimize the process.

The specification contains no disclosure of either the critical nature of the claimed arrangement (i.e.- the power range, the temperature range, the thickness range) or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen limitations or upon another variable recited in a claim, the applicant must show that the chosen limitations are critical. In re Woodruff, 919 F.2d 1575, 1578 (FED. Cir. 1990).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (571) 272-1695, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:0AM to 3:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached on (571) 272-1702. The fax phone number for this Group is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956 (**See MPEP 203.08**).

Thanh Nguyen
Patent Examiner
Patent Examining Group 2800